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AZ CORP COMMISSION
DOCKET CONTROL

TEP

Tucson Electric Power

88 East Broadway Blvd., P.O. Box 711
Tucson, Arizona 85702

April 1, 2016

Docket Control
Arizona Corporation Commission
1200 West Washington Street
Phoenix, AZ 85007

Re: Notice of Filing – Tucson Electric Power Company's 2016 REST Compliance Report for the year ended 2015, Docket No. E-00000R-16-0084

Pursuant to Arizona Administrative Code R14-2-1812, each Affected Utility shall file with Docket Control a report that describes its compliance with the requirements of the Renewable Energy Standard and Tariff ("REST") Rules. Tucson Electric Power herby files its 2016 REST Compliance Report for year-end 2015.

Because the Report contains confidential information, such information has been redacted from this filing. The un-redacted Report shall be provided directly to Staff pursuant to the terms of the Protective Agreement executed in Docket No. E-00000R-16-0084.

If you have any questions, please do not hesitate to contact me at (520) 884-3680.

Sincerely,

Melissa Morales
Regulatory Services

cc: Compliance Section

Arizona Corporation Commission
DOCKETED

APR 01 2016

DOCKETED BY

Tucson Electric Power

Response to R14-2-1812 Utility Reporting Requirements of the Arizona Corporation Commission

COMPLIANCE REPORT AND RENEWABLE ENERGY DATA FOR 2015

Tucson Electric Power Co. | PO Box 711, Tucson, AZ 85702

Table of Contents

Executive Summary

Compliance with 2015 Renewable Energy Standard ("RES") Requirements

For calendar year 2015, the Arizona Corporation Commission ("ACC" or "Commission") established an annual RES requirement of 5.0 percent[1] of the utility's 2015 retail kilowatt-hour ("kWh") sales, with 30 percent[2] of the total requirement to be fulfilled with energy produced from Distributed Renewable Energy ("DRE") Resources. This separate DRE carve-out provision requires that one-half[3] of the total DRE requirement come from residential resources and one-half from non-residential resources. For the purposes of RES compliance tracking, A.A.C. R14-2-1801(N) defines a Renewable Energy Credit ("REC") as the unit created to track kWh derived from a DRE or kWh equivalent of conventional energy resources displaced by a DRE; however, throughout this Compliance Report, Tucson Electric Power Co. ("TEP" or "Company") discloses its production in both kWh and RECs.

In 2015, the Company's total Eligible Renewable Energy Resources, including Annualized Production and Reservations, were 808,724,212 kWh, which is equivalent to 8.9 percent of TEP's total 2015 retail sales. Total DRE resources for the year was 190,511,475 kWh. Total Residential actual production was 90 percent of the 2015 residential requirement, and Non-Residential actual production was 191 percent of the 2015 non-residential requirement. TEP will retire 452,653,400 RECs for 2015 (Actual production of Residential DRE of 60,770,084; Non-Residential DRE of 129,741,391; and Non-DRE of 262,141,925).

The Company intends to request a waiver to the residential DRE requirement in its pending 2016 RES Implementation Plan that is scheduled for hearing on April 5th, 2016. As shown in Table 1b, the annual residential DRE compliance measure required the retirement of 67,898,010; however, the Company only has the rights to retire 60,770,084 residential DRE RECs. However, consistent with Commission Decision No. 74882 and the associated changes to the Arizona RES to acknowledge all renewable resources within the Company's service territory, the Company is requesting a waiver based on the production values shown in Table 1a for the total non-incentivized DRE production, for which the Company has no right or claim to retire the associated RECs.

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[1] A.A.C. R14-2-1804(B)
[2] A.A.C. R14-2-1805(B)
[3] A.A.C. R14-2-1805(D)

Company's Eligible Renewable Energy Resources

Table 1a shows the following information:

1. Actual energy production[4]
2. Annualized energy production[5]
3. Generation capacity, disaggregated by technology type[6]

Table 1a

Resource	Install Year	Technology	Ownership	MW(AC)	MW(DC)	Production (Actual) kWh	Production: Actual/(Annualized)[2] kWh	Multiplier Credits[3]	Total kWh or Equivalent
Utility Owned:									
Springerville 1	2001-2004	Fixed Tilt	TEP	3.68	4.60	8,858,803	8,858,803	1.50	13,288,205
Springerville 2	2010	Fixed Tilt	TEP	1.45	1.81	3,485,747	3,485,747	1.00	3,485,747
White Mountain	2014	Fixed Tilt/LCPV	TEP	8.25	10.00	2,774,391	2,774,391	1.00	2,774,391
Solon Tech Park 1	2010	Single Axis	TEP	1.28	1.60	2,606,835	2,606,835	1.00	2,606,835
Solon Tech Park 2	2011	Fixed Tilt	TEP	4.00	5.00	7,657,297	7,657,297	1.00	7,657,297
HQ	2012	Fixed Tilt	TEP	0.04	0.05	-[7]	-	1.00	-
Warehouse OH	2012	Fixed Tilt	TEP	0.40	0.50	1,016,474	1,016,474	1.00	1,016,474
Prairie Fire	2012	Fixed Tilt	TEP	4.00	5.00	8,644,608	8,644,608	1.00	8,644,608
DeMoss-Petrie	2001	Fixed Tilt	TEP	0.18	0.22	127,989	127,989	1.00	127,989
Sundt Augmentation	2014	Solar Steam Augmentation	TEP	5.00		12,264,431	12,264,431	1.00	12,264,431
Power Purchase Agreements:							-		
Amonix	2011	Dual Axis	PPA	1.20	2.00	1,008,769	1,008,769	1.00	1,008,769
Gatos Montes	2012	Fixed Tilt	PPA	4.92	6.00	9,605,310	9,605,310	1.00	9,605,310
NRG Avra Valley	2012	Single Axis	PPA	25.00	34.41	71,027,695	71,027,695	1.00	71,027,695
Picture Rock	2012	Single Axis	PPA	20.00	25.00	52,681,324	52,681,324	1.00	52,681,324
E. ON UASTP	2012	Single Axis	PPA	4.80	6.60	12,583,445	12,583,445	1.00	12,583,445
E. ON Valencia	2013	Single Axis	PPA	10.00	13.20	23,223,872	23,223,872	1.00	23,223,872
Los Reales Landfill	1998	BioMass	PPA	4.00		31,599,779	31,599,779	1.50	47,399,669
Avalon	2014	Single Axis	PPA	28.34	35.00	76,594,416	76,594,416	1.00	76,594,416
Cogenra	2014	CPV Single Axis	PPA	1.10	1.38	1,223,471	1,223,471	1.00	1,223,471
Red Horse Solar	2015	Single Axis	PPA	41.00	51.25	56,439,797	102,500,000[2]	1.00	102,500,000
Red Horse Wind	2015	Wind	PPA	30.00		23,798,323	60,000,000[2]	1.00	60,000,000
Macho Springs	2011	Wind	PPA	50.40		109,380,000	109,380,000	1.00	109,380,000
Manufacturing Credit		PV	Global Solar		0.81	1,767,343[3]	1,767,343	1.00	1,767,343
Gross Total									620,861,290
Adjustments for 10% Wholesale DRE applied to Non-Res. requirement						(13,579,602)	(13,579,602)		(13,579,602)
Total Production of AC & DC Facilities						**504,790,517**	**587,052,397**		**607,281,688**
Subtotal Capacity AC Facilities				**89.40**					
Subtotal Capacity of DC Facilities including AC Equivalent Value				**159.64**	**204.42**				
Total AC Generation Capacity (excl. credits)				**249.04**					

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[4] As required by A.A.C. R-14-2-1812(B)(1)

[5] As required by A.A.C. R-14-2-1812(B)(2)

[6] As required by A.A.C. R-14-2-1812(B)(3)

Table 1a continued.

Distributed Renewable Energy (DRE): Residential:	Install Year	Technology	Ownership	MW(AC)	MW(DC)	Production (Actual) kWh	Production (Annualized)² kWh	Multiplier Credits³ =	Total kWh or Equivalent
Incentive, Installed									
Purchase-Incentive		PV	Customer Owned		17.57				
Lease- Incentive		PV	Leased		14.46				
Total PV					**32.03**	**53,988,550**	**53,988,550**	**1.00**	**53,988,550**
Thermal		Thermal	Customer Owned			6,740,250	6,740,250	1.00	6,740,250
Total - Incentive Installed					**32.03**	**60,728,800**	**60,728,800**		**60,728,800**
Utility-Owned									
Installed									
Total PV-Utility Owned	**2015**	**PV**	**TEP**		**0.26**	**41,284**	**494,000**	**1.00**	**494,000**
Total Residential Eligible DRE						**60,770,084**	**61,222,800**		**61,222,800** (B)
Subtotal Capacity of DC Facilities including AC Equivalent Value				**27.45**	**32.29**				
Total AC Generation capacity (excl. credits)				**27.45**					
Non-Incentive									
Installed									
Purchase		PV	Customer Owned		9.21				-
Lease		PV	Leased		27.84				-
Total PV					**37.05**	**39,085,878** [5]	**66,690,000**	**1.00**	**66,690,000**
In-Progress									
Purchase-Non-incentive		PV	Customer Owned		1.69				
Lease-Non-Incentive		PV	Leased		5.69				
Total PV					**7.38**		**13,281,244**	**1.00**	**13,281,244**
Subtotal Non-Incentive Res DRE Installed & In Progress				**37.76**	**44.43**	**39,085,878** [5]	**79,971,244**		(G)

Non-Residential, summations and notes on following page.

Table 1a continued.

Non-Residential:	Install Year	Technology	Ownership	MW(AC)	MW(DC)	Production (Actual) kWh	Production (Annualized)[2] kWh	Multiplier Credits[3]	Total kWh or Equivalent
Incentive, Installed									
Up-Front Incentives (UFI)									
Purchase-Incentive		PV	Customer Owned		4.30			1.00	-
Lease-Incentive		PV	Leased		1.39			1.00	-
Total PV					**5.69**	**8,106,115**	**8,106,115**	**1.00**	**8,106,115**
Thermal		Thermal	Customer Owned			4,670,985	4,670,985	1.00	4,670,985
Wind		Wind	Customer Owned	0.01		7,074	7,074	1.00	7,074
Daylighting		Daylighting	Customer Owned			188,539	188,539	1.00	188,539
Total UFI				**0.01**	**5.69**	**12,972,713**	**12,972,714**		**12,972,714**
Performance-Based Incentives (PBI)									
PV		PV	Customer Owned		41.33	72,202,975	82,681,307	1.00	82,681,307
Chilling		Chilling	Customer Owned			1,482,703		1.00	1,482,703
Total PBI					**41.33**	**73,685,678**	**82,681,307**		**84,164,010**
Total Incentive Installed				**0.01**	**47.02**	**86,658,391**	**95,654,021**		**97,136,724**
Utility-Owned									
Fort Huachuca	2014				17.20	29,298,214	29,298,214	1.00	29,298,214
Wholesale (10% of DRE Req.)						13,579,602			13,579,602
Residential Extra Credits									
In-State Manufacturing and Installation Content						38,992			38,992
In-State Power Plant Installation Credit						83,096			83,096
Distributed Generation Credit						83,096			83,096
Total Production of AC & DC Non-Residential Incentive						**129,741,391**	**124,952,235**		**140,219,724**
Subtotal AC Facilities				**0.01**					
Subtotal Capacity DC Facilities including AC Equivalent Value				**54.59**	**64.22**				
Total AC Generation Capacity				**54.60**					
Non-Incentive									
Installed									
Purchased		PV	Customer Owned		26.44				
Leased		PV	Leased		0.84				
Total PV					**27.29**	**26,105,890** [6]	**49,114,800**		
In Progress									
Purchase		PV	Customer Owned		25.33				
Lease		PV	Leased		0.86				
Total PV					**26.19**		**47,142,000**		
Subtotal Non-Incentive Non-Res. - Installed & In Progress				**45.45**	**53.48**	**26,105,890**	**96,256,800**		
Subtotal Eligible DRE				**82.05**		**190,511,475**	**186,175,035**		**201,442,524**
Subtotal Non-Incentive DRE				**83.22**		**65,191,768**	**176,228,044**		**79,971,244**
Total RES Resources				**331.09**		**695,301,992**	**773,227,432**		**808,724,212**
Total 2015 RES Resources Available for Retirement[4]									**695,301,992**
Total AC Capacity & AC equivalent[2]				**331.09**					

Notes to Table 1:

1 Assumes the following kWh per installed kW:
   Residential and Non-Residential: 1800 kWh/kW (based on average systems installed)
   Residential Utility Owned : 1900 kwh/kW (newer technology installed)
   Utility Generation, Fixed Tilt: 1800 kWh/kW
   Utility Generation, Single-Axis Tracker: 2000 kWh/kW
   Utility Generation, Dual-Axis Tracker: 2200 kWh/kW
   Utility Generation, Wind: 2000 kWh/kW

2 Red Horse's Solar and Wind Annualized values represent the full capacity of the plants.
   The MW(AC)equivalent is the summation of the Utility Owned MW(AC) value plus the DG DC capacity converted from DC to AC using an 85% DC-AC conversion factor.

3 Extra Credit Multipliers

Early Installation Extra Credit: Installed and Began Operating in		
2001	0.30	
2002	0.20	
2003	0.10	
Manufacturing Credit Multiplier	2,190.00	
In-State Power Plant Extra Credit (1997-2005)	0.50	
In-State Manufacturing and Installation Content (1997-2005)	0.50	X (% in-state content in installed plant)
DE Solar Electric Generator and Solar Incentive Program (1997-2005)	0.50	

4 Does not include Annualized Production or Reservations

5 The Residential Non-Incentive projects had actual production of 39,085,878 kWh during 2015

6 The Non-Residential Non-Incentive projects had actual production of 26,105,890 kWh during 2015

7 HQ solar rooftop system had a broken inverter and additionally needed to be removed due to roof concerns. Therefore, zero production in 2015.

Renewable Energy Credit Retirement Summary

Table 1b shows the breakdown of RECs used to satisfy both the annual renewable energy requirement and the DRE requirement[7].

Table 1b

			Compliance Measure (kWh)	Available RECs for Retirement	Carryforward
Retail Sales	Actual kWh Sales		**9,053,068,000**		
2015 Carryforward Balance					
Non-DRE Balance				357,959,000	357,959,000
Total RES Requirement	% of Retail Sales	5.0%	**452,653,400**		
DRE Requirement	% of RES Requirement	30%	**135,796,020**		
Residential DRE	% of DE Requirement	50%	**67,898,010**	60,770,084	-
Non-Residential DRE	% of DE Requirement	50%	**67,898,010**	129,741,391	-
Non-DRE	= Total RES Requirement - Residential RECs[1] - Non-Residential RECs[1]		**262,141,926**	504,790,517	242,648,591
Total Resources Available for Retirement				**1,053,260,992**	
Retirement					
Residential DE				**452,653,400**	
Non-Residential DE				60,770,084	
Non-DE				129,741,391	
				262,141,925	
Total 2016 Carryforward Balance					**600,607,591**

Carryforward RECs + Non-DE RECs - Non-DE Retired RECs

[7] As required by A.A.C. R14-2-1812(B)(5)

Renewable Energy Standard Incentive Costs

Table 2b shows cost information regarding $/kWh of energy obtained from eligible renewable energy resources and $/kW of generation capacity, by technology, that can be attributed to the RES[9] for 3rd-party projects receiving incentives.

Table 2b

Residential	MW	MWh	($/MW)[1]	($/MWh)[1]			Total Incentives Paid ($)
Up-Front Incentives							
Thermal		25.81		400.00			10,324.00
Subtotal: Residential							**$ 10,324.00**

			Up-Front Incentives		Incentives		
	MW	MWh	($/MW)[1]	($/MWh)[1]	($/MW)	($/MWh)	Total Incentives Paid ($)
Non-Residential							
PBI Legacy							
PV		72,203.00				98.21	7,090,776.73
Solar Chilling		1,483.00				107.36	159,216.30
Subtotal: Non-Residential							**7,249,993.03**
Total DE Incentive Costs							**$ 7,260,317.03**

Notes to Table:

[1] Based on expected annual system production.

[9] As required by A.A.C. R14-2-1812(B)(4)

ACC Approved Budget

January through December 2015

	Jan - Dec 15
Revenue	
Tariff Billing	33,291,969
Carryforward from Previous Year	6,826,417
Total Revenue	40,118,386
Expenses	
Purchased Renewable Energy	
AMCCCG	22,971,774
TEP Owned	8,022,530
Total Purchased Renewable Energy	30,994,304
Customer Sited DG	
Consumer Education and Outreach	100,000
Meter Reading	35,363
Production Based Payment	7,214,196
Total Customer Sited DG	7,349,559
Technical Training	85,000
Information Systems	100,000
Metering	501,680
Labor & Administration	
Internal Labor	468,442
External Labor	302,401
Materials, Fees & Supplies	60,000
AZ Solar Website	4,000
Total Labor & Administration	834,843
Research & Development	
University Support	253,000
Total Expenses	40,118,386
Net Revenue	$ -

RES Revenue Expenses

January through December 2015

	Jan - Dec 15
Revenue	
Tariff	$ 33,549,928
Total Revenue	33,549,928
Expenses	
Purchased Renewable Energy	
AMCCCG	21,858,047
Manufacturing RECs	44,184
O&M	29,891
TEP Owned	7,771,910
Total Purchased Renewable Energy	29,704,032
Customer Sited DRE	
Consumer Education and Outreach	99,673
Production Based Payment	7,299,698
Reserved Up-Front Incentives	10,324
Total Customer Sited DRE	7,409,695
Technical Training	84,245
Information Systems	98,086
Metering	
Metering Other	592,326
Metering	592,326
Labor & Administration	
Internal Labor	477,080
External Labor	289,118
Materials, Fees & Supplies	59,832
AZ Solar Website	3,053
Total Labor & Administration	829,083
Research & Development	253,000
Total Expenses	**38,970,468**
Net Revenue(Loss) for 2015	**(5,420,539)**
Carryforward from Prior Years	**6,826,417**
Net Revenue to Carry forward	**$ 1,405,877.71**

Budget Variance Report

Below is a description of the budget variances that were realized between the ACC approved budget, shown on page 9, and the RES program actual expenses, shown on page 10.

The total Expenses in 2015 of $38,970,467 exceeded the Tariff Revenue of $33,549,928 by $5,420,538. This leaves a balance of $1,405,878.71 to carry forward to TEP's 2017 Implementation Plan.

Purchased Renewable Energy – Over-collection was due to the following:

PPAs

- Avalon Phase II- 17.22 MW Solar PV PPA: Delays in construction and interconnection caused this project to be commercially operational in March 2016, rather than December 2015, as expected.

TEP-Owned

- Ft. Huachuca Phase II 4 MW Solar PV: Significant delays from non-compliant design and work created a requirement for engineering redesign. Therefore Phase II was not completed by the end of 2015, as forecasted.

Due to the delays in Ft. Huachuca Phase II, TEP was not able to realize the authorized return on investment, and depreciation for the original time period anticipated.

These projects qualified for FERC-required accruals for Allowance for Funds Used During Construction ("AFUDC") in lieu of a return on investment on construction expenditures collected through the REST in 2015. The accrued AFUDC will be recovered over the useful lives of the projects through depreciation expense.

Metering – Under-collection was due to Residential DRE being considerably more active in 2015 than was anticipated in the 2015 Implementation plan.

Performance-Based Incentives – The Company requested a lower PBI budget to account for lower payments in prior years.

Up-Front Incentives – There were a few Solar Hot Water Systems installed in 2016 which were reserved in 2015.

TEP-Owned Residential Solar Discussion

In the Company's 2015 REST Implementation Plan, the ACC approved the first year of a TEP-Owned Residential Solar ("TORS") Program. Per Commission order (Decision No. 74884) the overall program costs are capped at $10 million and TEP has limited the size of the Program to a maximum of 600 residential customers. Upon approval of the associated R-10 Tariff, the Company began implementing the program. This effort consisted of developing internal workflows, procedures and documents; while also creating partnerships with installers and material contracts with suppliers. The following report outlines these steps taken in greater detail.

Partner and Supplier Solicitations

Solar Installation Partners: The Company initiated a Request for Proposal ("RFP") process for solar installation partners in October 2014. This was an open, and transparent solicitation that was conducted utilizing the Company's existing procurement process. All solar installation companies that had been active in the Company's service territory, with a minimum of 10 residential PV reservations between January and September of 2014, were invited to participate. This minimum requirement resulted in 13 solar installation companies receiving notices of the Request for Information ("RFI") and the RFP. The Company received six (6) completed proposals in November 2014. In January 2015, the Company performed interviews with the six (6) respective companies. A short list of four (4) companies were invited back for a subsequent round of interviews with the Company. The Company then selected three (3) residential solar providers to partner with for the implementation of the TORS program:

- Customer Solar and Leisure, LLC (Tucson, AZ)
- Technicians for Sustainability, LLC (Tucson, AZ)
- Solar Solution AZ, LLC (Tucson, AZ)

The Company selected three (3) solar installation partners based on the following criteria:

- Price Proposal (50%)
- Qualifications & Experience (30%)
- Method of Approach (10%)
- Safety Program (10%)

Master Service Agreements ("MSA") were signed with the three (3) solar installation partners in February 2015. These agreements included a fixed unit fee negotiated independently with each solar installation partner that each would charge to:

- Assist with document execution and collection
- Permit the solar photovoltaic ("PV") system
- Pick up key system components from TEP and supply balance of system ("BOS")
- Install the solar PV system

- Coordinate Authority Having Jurisdiction ("AHJ") inspections of solar PV system
- Commission solar PV system

Solar PV module supplier: In February 2015, TEP issued an RFP to solar PV module manufacturers. The Company issued the competitive solicitation to five (5) PV module manufacturers. The Company selected REC Solar to supply the PV modules for the TORS program based on the following criteria:

- Quality – Top tier module: REC 270TP
- Price Security – Not subject to Chinese anti-dumping tariffs
- Price - REC Solar offered the best pricing as they valued the relationship with TEP and this program more than their competitors

The Company signed an MSA with REC Solar for 3.591 MW of REC 270TP modules. The contract included shipping to the Company's Irvington campus in Tucson, AZ. The order was staged in three (3) separate deliveries to roughly track the roll-out of the program. The first shipment arrived in early May 2015, and the final shipment in December 2015. The Company's Material Management Services department has incorporated the REC Solar modules into TEP's general inventory and is currently managing that inventory as part of its overall general function within the Company.

Inverter supplier: In February 2015, TEP issued an RFP to solar PV residential inverter manufacturers. The Company issued the competitive solicitation to six (6) residential inverter manufacturers. The Company selected Fronius to supply the residential grid-tied inverters for the TORS program based on the following criteria:

- Quality – Fronius is consistently rated in the top 5 performing string inverters
- Security – Fronius manufacturing facility is in Portage, Indiana
- Relationship – Fronius had an existing relationship with TEP and has similar Research and Development ("R&D") philosophies
- Price – Fronius offered the best pricing as they valued the relationship with TEP and this Program more than their competitors

The company signed an MSA with Fronius for 3.521 MW of residential solar. The contract included shipping to the Company's Irvington campus in Tucson, AZ. The order was staged in three (3) separate deliveries to roughly track the roll-out of the Program. The first shipment arrived in early May 2015, and the final shipment in January 2016. The Company's Material Management Services department has incorporated the Fronius inverters into the Company's general inventory and is currently managing that inventory as part of its overall general function within the Company.

Contracted Prices: The Company received contracted pricing that came in well below initial budgeting estimations used for planning and proposal purposes. The inverters and modules were procured for a total combined price of $0.93/watt. The weighted average of the solar installation partner's fixed unit installation fee is $1.22/watt. The Company cannot break out pricing beyond these figures due to Non-Disclosure Agreements ("NDA") currently in effect.

Company partner and supplier experience: Over the course of the TORS program to date, the Company has had a very positive experience with both the local solar installation partners, as well as the material suppliers. The Company intends to build on these existing relationships so that they provide even more value to the Company, the installers, the suppliers, the TORS participants and the Company's ratepayers if the program is authorized to continue.

Program Marketing and Participant Acquisition

TORS program marketing: The Company has done very little marketing of the TORS program to date. All marketing has been limited to the following activities:

- Standard Company press releases
- Standard Company newsletter article
- Standard Company website
- Standard Company social medial posts
- Company, installer and participant word-of-mouth

Press releases: The Company issued a total of two (2) press releases directly related to the TORS Program. The first press release was sent out on December 18th, 2014 following ACC approval to announce the newly approved tariff and TORS program. The second press release was sent out on March 4th, 2015 to announce the installer partners TEP had selected through the competitive solicitation.

Company newsletter: The Company included a total of one (1) article dedicated to the TORS program in the Company's monthly newsletter - Plugged In. This newsletter is distributed electronically to a distribution list of approximately 80,000 active subscribers. This article was included in the January 2015 issue and titled "TEP Residential Solar Program." The Company also referenced the TORS program in the August 2015 issue in an article titled "Most Solar, Less Money." This article was focused more on the Company's 2016 Renewable Energy Standard and Tariff ("REST") Implementation Plan ("IP") and included other programs such as the proposed Residential Community Solar program, the existing Bright Tucson Community Solar program and REST budget in general.

Company website: The Company added a TORS program banner to the Company's existing website – www.tep.com. As a matter of the existing website structure, the TORS program banner was in rotation with five other banners that cycle automatically.

Company social media: The Company actively manages a social media presence on Facebook, Twitter and LinkedIn. From time to time the Company has created posts promoting the TORS program on its respective accounts. Additionally, for several months after the initial announcement of the TORS program, the banner image for both the Facebook and Twitter accounts was the TORS promotional banner.

Word of mouth: The Company is aware of customers becoming aware of the TORS program through word of mouth. While this is an expected outcome of the Company's other promotional activities for the TORS program described above, it was not the result of a strategic or concerted effort to generate such promotion.

TORS Interest list: To the extent that any of the activities above should be considered "marketing" in the general sense of the word, they worked to create an awareness of the program and direct customers interested in the TORS program to the Company's website in order to register their interest. The Company has often referred to this as "The Interest List." The portal for customers to register their interest was added to the website immediately following the Commission's approval of the tariff and program. The interest list grew to over 2,000 very soon after the initial press release. Since the initial surge in registered interest, the interest list has grown to over 5,500.

Application periods: In order to manage the high level of registered customer interest in the TORS program, the Company limited the announcement of publicly available application periods for the TORS program to those registered on the interest list. The following is a list of when these applications periods have taken place and how many pre-qualified applications were received:

- July 1st, 12pm: 298 applications
- September 8th, 12pm:275 applications
- December 16th, 12pm:177 applications
- February 15th, 12pm:175 applications

The Company considers pre-qualified applications qualified when the following criteria have been met:

- The homeowner is listed on the Company's account
- Ownership of home is verified
- Customer had a minimum usage of 6,700 kWh in previous 12 months
- Customer has a minimum payment history score with the Company for the previous 12 months

Customer site visits and contract execution: Qualified applications are then divided up amongst the Company's three (3) installation partners. The installation partners schedule an on-site visit with the homeowner. During this site visit the solar installation partner will present the TORS program to the customer, including customer-specific TORS details such as the fixed monthly payment and usage bandwidth. The solar installation partner will also review the property and home to ensure it is suitable for the installation of a TORS solar PV system. If the home is suitable for a solar PV system, the customer then, at this point, has the opportunity to execute the TORS program contract. The solar installation partner will also create a document called the Authorization to Proceed ("ATP") that details the customer-specific program details and the site-specific solar PV system design. The Company reviews this document to ensure that the system design meets the TORS program criteria. Upon Company approval, the ATP is presented to the customer for their approval. The customer is considered a program participant once both the TORS contract and ATP have been signed.

System Permitting, Installation and Commissioning

System permitting: Every TORS PV system is permitted and inspected by the appropriate AHJ. There are five (5) AHJs that exist within the Company's service territory:

- The City of Tucson
- Pima County
- The Town of Marana
- The Town of Oro Valley
- The Town of Sahuarita

Each solar installation partner is responsible for creating and submitting the required documents and drawings to receive a permit from the respective AHJ.

Material requisition: Each project is entered into the Company's workflow management software by the solar installation partner. The Company's solar installation partners pick up the key system components from the Company on a per-job basis. The key system components for a solar PV system are the following:

- REC 270TP solar PV modules
- Fronius residential grid-tied inverter(s)
- DG meter socket
- DG fused disconnect
- TEP placards

The Company's Material Management Services department pulls the inventory and stages it for pick-up by the installers as a matter of their general daily activities. The Company's solar installation partners have been granted access to the Company's Irvington Campus after registering with Facilities Physical Security, as are other Alliance Contractors partnered with the Company.

System Installation: The Company's solar installation partners are responsible for all aspects of the PV system installation. They are responsible for the following with respect to system installation:

- Scheduling the installation of the PV system with the program participant
- Supplying all balance of system ("BOS") materials required to complete the installation (conduit, wire, hardware, etc.)
- All labor associated with installing the key system components and BOS

Installation times for TORS PV systems can range from one (1) to (5) days depending on the size and complexity of the PV system and the size of the installation crew.

System Inspection: Upon completion of the PV system installation, the solar installation partner is responsible for scheduling and coordinating any required AHJ inspections. These inspections would include at a minimum a Final Electrical and Final Building inspection. A successful AHJ inspection will drive a DG production meter set in the same manner as 3rd-party DG production meter sets.

System Commissioning: The solar installation partner is also responsible for commissioning the PV system. As a part of this commissioning process, they are required to document the following:

- Correct key system components are installed per job allocation
- PV system orientation matches that approved by the Company and participant on the ATP
- PV system performance meets expectations based on PV system specifications

The solar installation partner documents these commissioning components using a Commissioning Worksheet developed by the Company specifically for the TORS program. The Commissioning Worksheet is then submitted to the Company upon completion as part of the system close out process.

Internal and External Program Management

Application management: The Renewable Energy Resources Department uses the program management platform PowerClerk ("PC") for both 3rd-party DG applications and TORS applications. The Company manages each TORS project from customer application to project completion and closeout within PC. Each application received during application periods is entered into PC. From there the application follows a customized workflow developed by the Company for the TORS program. Both TEP personnel and the solar installation partners shepherd the application through the TORS workflow as appropriate. The solar installation partners have specific roles within PC that allow them to manage the application externally in a complimentary manner to the internal application management performed by TEP. Eventually, if an application is qualified, the home suitable for a solar PV installation and the customer elects to participate, the application becomes a project. Program documentation such as the customer contract is generated by the solar installation partner via PC. Executed customer contracts and ATPs are uploaded into PC by the solar installation partners. With this capability, PC serves as the initial repository for all project documentation. PC also serves as the system of record for all submitted TORS applications that are not pre-qualified, are not suitable for a solar PV system or do not move forward due to customer choice.

Project management: Upon contract and ATP execution, an application becomes a project as it continues to move through the PC-TORS workflow. Both the solar installation partner and the Company continue to have internal and external roles to play in managing the project. While the project remains within the PC-TORS workflow, the project is also entered into the Company's general T&D workflow management system Maximo. At this point, the project progresses through parallel workflows within both PC and Maximo. The solar installation partner and the Company continue to manage the project within each workflow management system independently, with each workflow management system having unique workflows and touch points to achieve unique objectives. PC continues to serve as the repository for project documentation throughout the PC project workflow, as the solar installation partner uploads the PV system permit package, the Certificate of Completion ("COC") and the commissioning worksheet as they are created and completed. Upon successful completion of the project indicated by an uploaded COC and commissioning worksheet, the Company reviews the PV system for completeness, adequacy and suitability. The commissioning worksheet includes photos of the PV system that allows the Company to complete this review process remotely; however, the Company performs on-site reviews of TORS PV system as spot checks. Based on the Company's review, the PV system is accepted or rejected. The solar installation partner is notified in either regard. If a PV system is rejected, the solar installation partner must remedy or fix the issue that caused the rejection and then the PV system will be subject to another review by the Company.

Project closeout: Upon a successful review of the PV system that includes review of the COC, the commissioning worksheet and may include an on-site review, the Company will accept the PV system. The solar installation partner receives notice of the Company's acceptance via PC and submits an invoice to the Company. The invoice will be based on the fixed unit fee agreed upon within the MSA and the PV system capacity. The Company matches PV system invoices from the solar installation partners with PV system acceptances and pays the invoice. All program documentation is collected from PC and uploaded to the Company's general repository referred to as Documentum. The project is then considered completed and closed out. Upon completion and close-out of a project, the participant is sent a close-out package that consists of the following:

- A 60 watt-equivalent LED light bulb
- A PV system manual
- A Thank You letter

A week later, the participant is emailed a TORS satisfaction survey using Qualtrics. The Company's Customer Care department uses Qualtrics to perform thousands of customer surveys as a matter of general Company business. The TORS program is able to use the Qualtrics system for TORS satisfaction surveys at no additional cost.

Technical Requirements and Pursuits

Technical interconnection requirements: TORS PV systems are interconnected to the grid on the Company's side of the meter. This is a technical and physical difference when compared to traditional 3rd-party solar installations. While there are generally ample and simple opportunities to interconnect 3rd-party DG PV systems to the customer's side of the utility revenue meter, there are not such opportunities generally available to interconnect a DG PV system to the Company's side of the utility revenue meter. It was important that the TORS program interconnect to the Company's side of the customer's utility meter for the following reasons:

- DG PV system is interconnected to what is considered the Company's distribution system serving all customers
- In the event the service is discontinued to the residence, the PV system continues to have access to the Company's distribution system and may continue to operate

- Participant keep standard utility revenue meter to meter energy delivered to the premise in the exact same manner as before the TORS PV system was installed

The Company developed an internal construction standard for the TORS program that details various methods of interconnecting DG PV systems to the Company's side of the meter – EC-1340. This standard was developed, created and implemented using the Company's standard method of developing and approving construction standards and service requirements. Due to the unique nature of EC-1340 when compared to 3rd-party DG PV interconnections, the Company met with affected AHJs that reside within the Company's service territory as part of the development of EC-1340. Early on in the process the Company specifically met with the two (2) largest AHJs: The City of Tucson and Pima County. They were afforded the opportunity to comment on the Company's initial concepts of the new interconnection method and process. These meetings took place at the offices of the respective AHJs; they were very collaborative, positive and productive. Further along in the development of EC-1340 the Company invited all AHJs to review and comment on the EC-1340 standard and process. These meetings took place at the Company's Irvington campus. They consisted of classroom review and discussion as well as on-site inspection of EC-1340 mock-ups in the Company's training yards. The solar installation partners were also included in the field review of the EC-1340 mock-ups in the Company's training yard.

This overall coordination with affected AHJs also included review of the solar installation partner's proposed permit documents and drawings. The Company helped to facilitate a dialog between the AHJs and the solar installation partners to ensure that the permit documents and drawings for the TORS PV systems provided the AHJs all the necessary information and in a relatively consistent manner.

Technical Pursuits: The tariff and ownership structure of the TORS program has afforded the Company the opportunity to pursue technical research and development ("R&D") goals and objects within the context of the TORS program. These R&D goals and objects include, but will not be limited to the following:

- Increased capacity-value orientations
  - Biased to the west for increased afternoon production
- Geo-targeted installations
  - Determining optimal DG placement on feeders for minimizing losses
- Advanced inverter settings
  - Voltage Ride thru
  - Voltage support
  - Frequency Ride thru
- Advanced inverter functionality based on two-way real-time secure communication with inverter
  - Centralized Coordination for Voltage Support
  - Centralized Coordination Ramp management with centralized energy storage

Increased capacity-value orientations: The Company's existing fleet of 3rd-party net energy metered ("NEM") systems has a production peak of approximately 12pm. As the Company approaches the summer system peak in the late afternoon and early evening, 3rd-party NEM PV production falls off quickly. The Company's solar installation partners are required to design all TORS PV systems with an azimuth orientation that falls within a specific range. The allowable azimuth range for TORS PV systems is between 150 degrees (30 degrees east of south) and 280 degrees (10 degrees north of west) with a preference for 270. This means that if the solar installation partner has the option of designing a TORS PV system to face south (180) or west (270) on the same residence, they are required to face the system west. This strong bias for a western orientation of the TORS PV fleet has resulted in a 2 hour shift of the TORS fleet production curve into the afternoon. This translates into significantly higher solar production in the late afternoon hours, especially in the summer. While TORS PV fleet production does decrease rapidly as the sun sets just like all solar PV generators, it will still be at approximately 50% of peak production at 5pm in the summer months. This is compared to 3rd-party NEM systems that are producing approximately 25% of peak production at 5pm. The above ratios are anticipated based on current production profiles of the TORS PV fleet and can't be confirmed until the summer months of 2016. However, the Company has a high degree of confidence based on current TORS and NEM PV production profiles.

Geo-targeted installations: As part of the broader TORS program implementation, the Company has investigated the opportunity to target particular feeders and substations that may provide enhance locational value. As stated in the Company's 2016 Renewable Energy Standard Implementation Plan ("RES IP") filed on July 1st, 2015:

> *"[T]he Company has also prioritized the participation of an additional fifty-seven (57) customers. These customers were identified from the interest list as being located on particular feeder circuits within the Company's distribution network that meet loading and communication criteria. Once installations have been completed on these circuits, TEP will begin to incorporate the systems into the energy management system in order to directly communicate with the PV systems." TEP 2016 RES IP*

Related Company initiatives: In addition to the work being done described above, the Company is working on a number of initiatives related to distributed generation and the inclusion of the TORS program. These initiatives include:

1. Creation of TEPs smart inverter operation requirements including lower frequency ride thru settings and voltage support. These settings will be running in our community owned solar PV facilities first and then once refined we'll request all other smart inverters under the company's control meet these operating criteria.
2. Ability to communicate and control the inverters via a wireless communication network, we have been successful with this test
3. Distribution generation feeder management system. This system will connect to the smart inverter test bed at the Irvington campus and will direct the inverter to produce and consume VARs based on the feeder's requirements.
4. Ramp management test, with 1 MW/1MWh battery to be collocated with a 4.5MWAC solar field, to determine the feasibility of various economic and technical operating modes.
5. One cycle control demonstration

6. Field measurement device installation on Drexel and Los Reales substation feeders for better voltage and power factor management.
7. DMS pilot for Drexel substation. Measurement and management systems need a way of reporting to the system operators status and measurement values. Situational awareness of data.
8. DMS application being introduced to provide more automation activities and better visualization
9. Incorporating DMS electrical model with distribution planning model to utilize field measurements (i.e. voltage, amperage, power, VAR and KWH and KVARH) to validate and modify model parameters to match actual
10. Testing other DMS applications for opportunities and business cases for implementation
11. West Ina Strategy - See attached latest version
12. IRP plan for technology
13. SEL synchrophaser project for one cycle.
14. Synchrophaser for EHV sites.
15. Alstom synchrophaser collaboration on software installation and data visualization.
16. Development of synchrophaser measurement tools
17. Management of settings of U of A tech park fiber network and communications. Remote setting changes for operations control and management.
18. Data storage of control and alarm parameters in PI system
19. Company-owned utility-scale inverter control
20. Maintenance software to monitor inverter performance and panels for corrective action
21. Creation of experiment and measurement document
22. GE/Alstom studies

West Ina Strategy: Additionally, the Company is providing a copy of the original strategy for the West Ina substation where a concentration of TORS facilities has been targeted. These initiatives and studies are in progress, and any public information resulting from these studies will be made available when they are completed.

Program Numbers To Date

Applications:

Total Pre-Qualified Applications:	950	
Total Qualified Customers	775	82%
Total Disqualified Customers	175	18%

Reason:

Low Customer Score:	66
Usage does not meet minimum requirement:	79
Low Customer Score & Usage does not meet minimum requirement:	6
Customer Elected to not move forward	8
Customer does not own Property	6
Duplicate Application	10

Contracts:

Total Contracts Created	519	
Total Executed	251	51%
In 14 day Window	27	
Customers Cancelled	241	49%

Reason:

No Longer Interested / Unresponsive	171
Contract Length	18
Savings	52

Installations:

	Number of Systems	kW DC
Pending Installs	110	610.38

	Number of Systems	kW DC
Total Systems In Service	141	807.57

Costs:

Projects in Process:	$ 1,330,043.68	Cost Per Watt:	$ 2.18
Installed Systems:	$ 1,773,330.59	Cost Per Watt:	$ 2.17
Recorder Fees / MSA:	$ 48,112.00		

Attachment

West Ina Distribution Automation

Changes in the supply, demand, and delivery of electricity are remodeling electric distribution systems at most North American utilities. Distributed energy resources (DERs) are leading many of these changes. By creating energy supply in new, small, intermittent, and distributed locations across the grid, DERs have required new levels of system flexibility. DERs have also created new opportunities for utilities to improve performance, lower costs, and satisfy customers.

To accommodate DERs and other innovations, electric utilities need to do more than make their distribution systems bigger. Instead, utilities need to make their distribution systems smarter. Smart distribution systems provide flexibility, capability, speed and resilience. To achieve new levels of performance, these smart distribution systems include new types of software, networks, sensors, devices, equipment, and resources. To achieve new levels of economic value, these smart distribution systems operate according to new strategies and metrics.

Through a series of steps, TEP is building a smarter electric distribution system. TEP's next step is to conduct the **West Ina Substation Test (WIST)**. Across 2016 and 2017, the West Ina substation will host a series of experiments assessing the readiness, technical performance, and economic performance of new distribution technologies and components.

Overview

The West Ina Substation Test (WIST) will manage, operate, and control distributed energy resources (DERs) installed along individual transformer feeders connected to West Ina substation transformers T1 and T2. These DERs will include residential solar, energy efficiency, demand response, and energy storage.

The WIST will operate these DERs according to new protocols (e.g., Volt-VAR optimization) in a series of experiments to understand the system impacts of the DERs. The new protocols will be designed to limit system and equipment stress, system losses, and voltage volatility within acceptable ranges.

The WIST will have four objectives:

> **(1) demonstrate the feasibility, reliability, and value of utilizing DERs to increase energy delivery efficiency;**
>
> **(2) demonstrate the feasibility, reliability, and value of utilizing DERs to lower system reinforcement costs;**
>
> **(3) identify preferred operation and control protocols for managing DERs within TEP's system; and**
>
> **(4) identify other costs and benefits that arise as a result.**

The WIST will first require a project management office (PMO), meeting regularly under Jim Taylor's direction. WIST program management will include representatives from many departments to help design the experiments to be conducted across 2017. Vendors and consultants will supply specialized expertise as needed.

The WIST PMO will begin its work by developing a ***WIST Project Plan***, including standard elements (e.g., objectives, budget, schedule, participants, resources, procurement, compliance, platform model, testing protocols, site preparation). The WIST Project Plan will be updated as the project proceeds through design, development, modeling, testing, and evaluation.

The WIST team will continue its work by developing a ***WIST Model***, specifying the technical architecture of the system, and describing its requirements under normal conditions and in failure modes. The WIST Model provides the fundamental baseline and analytic structure for the project. The WIST PMO will report to TEP management, and will conclude its work by delivering a WIST Evaluation Report.

The WIST will then design, test, and construct a ***test platform***, including upgrades to the substation and its feeders, a distribution optimization & control system, and a communications network. Next, the ***DERs*** will be recruited, qualified, networked, and tested. Once the test platform and these DERs are in place, the WIST ***operating scenarios*** will be developed and tested.

TEP will design, develop, test, and commission the WIST during 2016. The team will complete the project plan, the WIST model, the test platform, the operating scenarios, and the initial customer research. The WIST will operate across 2017, and will complete evaluation by early-2018.

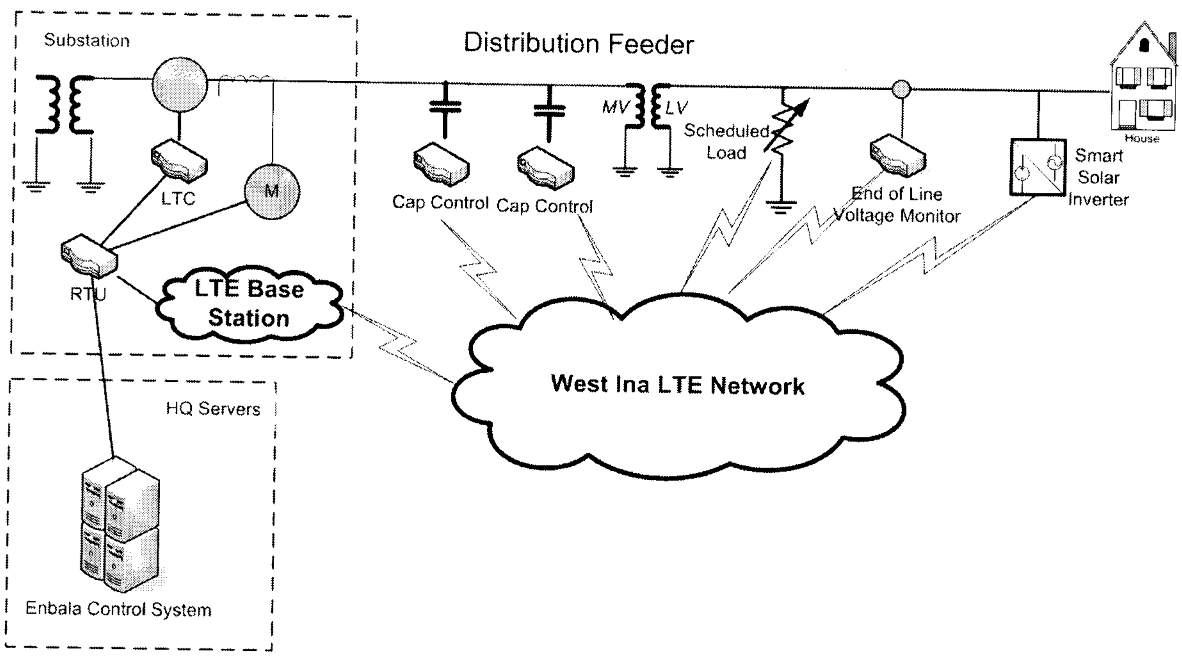

Figure 1 - Overview of WIST System Configuration

WIST operations will commence in 2017, as the operating scenarios are administered according to the project plan. Once the tests are complete and the data is verified, the WIST evaluation will take place, delivering final reports by June 2018.

We now describe the major elements of the WIST in turn.

The Test Platform

The WIST test platform will include three main components: upgrades to the substation and its feeders, a central control system, and a communications network.

Substation & Feeder Upgrades

The WIST team will ***upgrade the West Ina substation*** as required for WIST. The WIST model will have identified a range of metrics to be reported by existing and new sensors at the substation. WIST will require enhancements to LTC control (and potentially RTU control) as well as integration with the WIST Distribution Optimization & Control Platform. TEP Metering Services will be actively involved in this work stream.

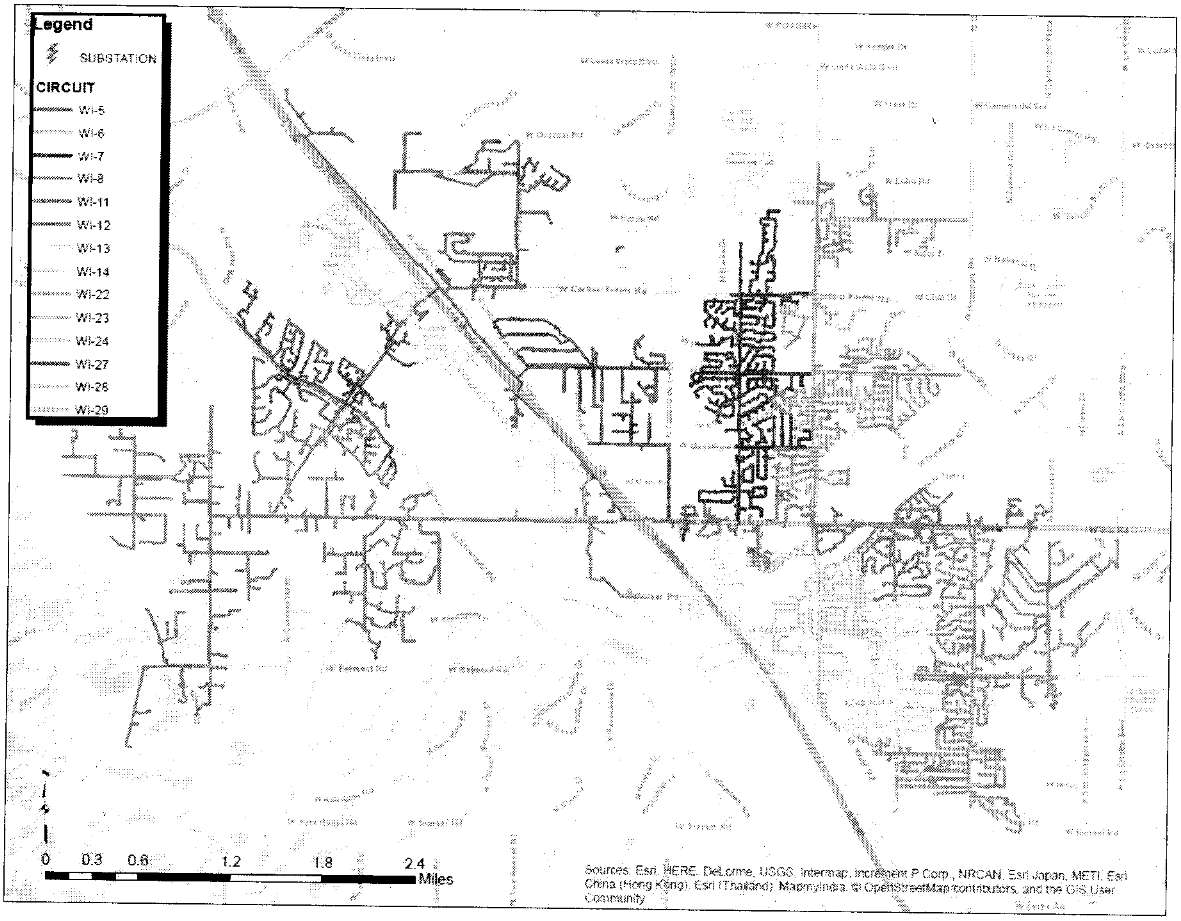

Figure 2 - West Ina Feeders

The West Ina Substation T1 and T2 LTCs will be automated for remote control or transformer values, with potential additional work required on the LTC Controller and RTU. All feeders will require metering telemetry. Additional sensors (e.g., synchrophasors) may be installed to enhance performance of the distribution optimization & control platform.

The WIST team will also ***upgrade the feeders connected to the West Ina substation*** as required for WIST. The WIST model will have identified a range of metrics to be reported by existing and new sensors on these feeders. The sensing capabilities, communications capabilities, number, and placement of capacitor banks and controllers will be adjusted as indicated by the WIST Distribution Optimization & Control Platform integration requirements. TEP Distribution Planning will be actively involved in this work stream.

Across the 10 distribution feeder circuits included in the WIST, capacitors will be moved, sited, and provided control and additional sensing capabilities as required. The Distribution Optimization & Control Platform will provide guidance. Phase balancing will be verified across the final array.

The upgrades to the West Ina substation and its feeders will be consistent with TEP's long-term plans for substation and distribution improvement, and will be feasible to operate at scale.

Distribution Optimization & Control Platform

The WIST team will design, procure, test, and deploy *a* ***distribution optimization and control platform*** consistent with the WIST Model. Modeling, architecting, specifying, and testing the WIST Distribution Optimization & Control Platform will be demanding in many respects (e.g., delivering a standard, scalable, and documented platform; selecting feeder and load optimization scenarios; demonstrating reliable DER response to frequency events; demonstrating synchrophasor interaction; integrating with the TEP SCADA system).

Considerable effort will be required to assure that the WIST Distribution Optimization & Control Platform will operate reliably and economically under a variety of scenarios and across a variety of functions (e.g., energy storage system management, circuit switching, load scheduling, asset management). DER frequency event response and synchrophasor interaction will need to be understood in detail, in order to properly place sensors.

The function of the distribution optimization & control platform will be to synchronize resource and system operations during the WIST experiments, so that the results are the best feasible given the operating protocols, the infrastructure in place, and field conditions. Because the DERs differ across many characteristics, and because the demands on these resources will differ strongly from day to day, the DER settings will vary greatly as well.

Providing dynamic and distributed control allows the DERs to contribute value as they would under a range of preferred operating conditions, and it allows DER interaction to be better understood.

Communications Network

The WIST team will design, procure, test, and deploy a ***3.65 GHz LTE network*** consistent with the WIST model. For the WIST, the 3.65 GHz LTE network will link together the DERs, sensors, and the optimization & control platform.

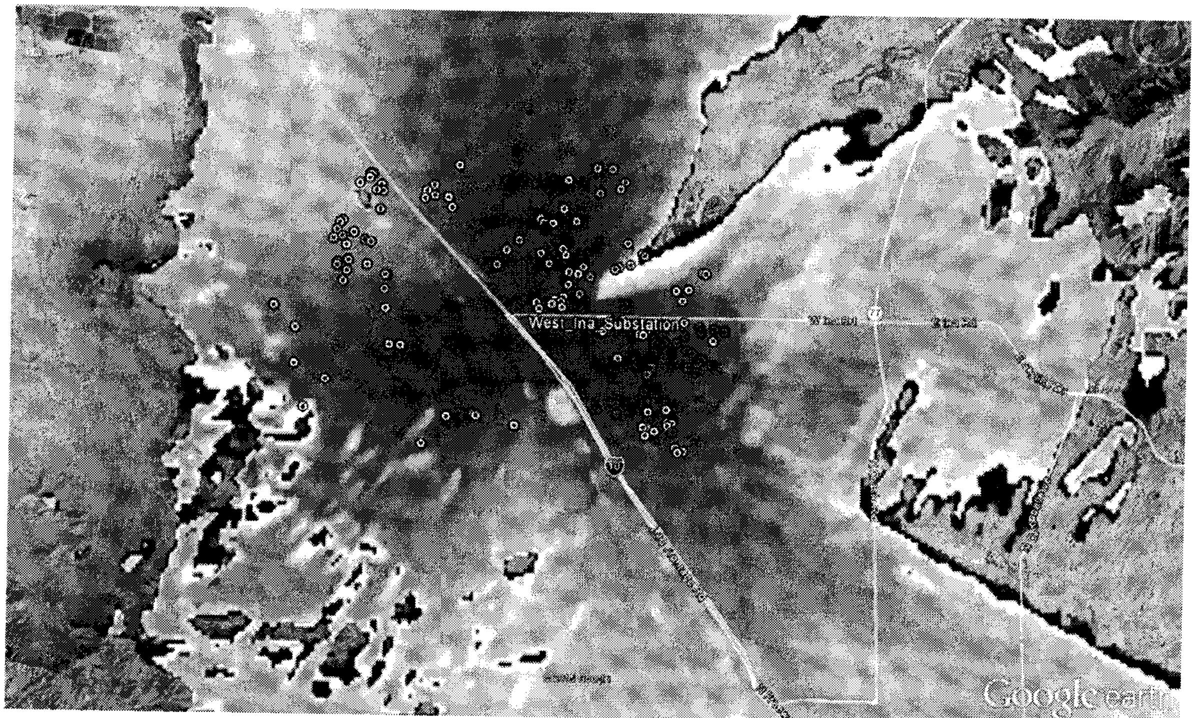

Figure 3 - West Ina LTE Signal Strength & Solar Applicants' Locations

An LTE network has been specified due to device, base station, and network compatibility and communications requirements (i.e., low endpoint cost, easy installation, low latency, high security and encryption, licensed frequency spectrum, and high bandwidth capabilities). The WIST network will require eNodeB collectors at LTE base stations linked to the network control system via an Ethernet backhaul network, as well as a link between the network control system and TEP's corporate field network. Each DER will also require a connection to the network. As indicated in Figure 3 above, initial propagation studies indicate a single tower installed at West Ina can communicate with all potential solar DERs.

While LTE networks have relatively standard and simple operations, modeling, architecting, specifying, and testing the WIST LTE network will require attention in many respects (e.g., pricing, monitoring, risk management, DER endpoint installation).

The components of the WIST Test Platform are not themselves being tested in this project. Rather, the substations, feeders, distribution optimization & control platform, and communications network will all be required to function properly so that the WIST experiments can proceed. The WIST team will have contingency plans in the event that one of the WIST Test Platform components encounters difficulties.

The DERs

The DERs and the system operating scenarios are the two elements being tested within WIST. The WIST includes a variety of DERs:

- Solar rooftop arrays
- Energy storage
- Demand response
- Energy efficiency
- Demand rates

The WIST team will design, procure, test, and enroll ***DERs*** consistent with the WIST model. While the nature and types of these resource additions will be consistent with TEP's long-term plans, and will be feasible to operate at scale, the resources specifically assembled for the WIST will be included with the WIST testing protocols in mind. Therefore, there will be a larger range of resources operated under a larger range of conditions during the WIST than would be typical of TEP's current operations.

As indicated above, the performance of these resources in the WIST will be assessed against standard TEP operations, and against the contribution of traditional distributed control devices (e.g., capacitors).

Procuring, enrolling, testing, and controlling these resources will be a major activity. For example, some residential solar resources have been preidentified for the WIST, but these need to be confirmed and enrolled. A role for 1 MWh battery storage resources in the WIST has been identified, but has not yet been specified. Some large-scale demand-response and energy-efficiency resources have been identified, but have not yet been contacted about the WIST, or enrolled. All of these new resources will have to be combined in modeling with the existing set of TEP resources and customer requirements.

After initial research across the existing loads carried by West Ina, and considering how DERs are likely to be represented across TEP's grid in the future, the objectives for additional DERS within WIST will be identified. Additional TEP-Owner Residential Solar participants will be recruited, aiming for 750 on the West Ina T1 and T2 feeders, contributing a total of 2 MW of transformer relief at peak. Additional storage DERs will also be sought.

Passive DERs (e.g., demand response, energy efficiency, demand rates) will be a major source of additional DERs for WIST, through specific recruitment in the West Ina area. While several large customers in the West Ina area are already active in TEP demand response and energy efficiency programs, and may be recruited into the WIST, an additional 950 kW of air conditioning may be required. TEP will enroll customers of many types into WIST, and will subject their usage to direct load control as indicated by the operating scenarios and the capabilities of the distribution optimization & control platform. Customers will be compensated, and will be encouraged to automate their usage to the degree possible.

Subject to regulatory approval, TEP also envisions utilizing the WIST to test residential customer reactions to rates that include demand charges. In appropriate numbers to yield a satisfactory sample, residential customers in the West Ina area will be recruited into a trial program of rates that include demand charges. A sufficient control group of customers outside the West Ina area will also be recruited. Because rates influence bills and bills influence behavior, TEP anticipates that customers may change their behavior as they transition to rates including demand charges. The new usage habits that customers develop may indicate the role of residential DERs for TEP in the future.

The planned consumer test illustrates that the WIST will inform TEP about the development, management, and maintenance of various DERs. According the operating scenarios it anticipates, TEP will come to value different DERs differently.

The Operating Scenarios

Distribution system operating scenarios are the second element being tested within WIST. Currently TEP models and balances its distribution resources according to the infrastructure deployed, the demand and supply of energy, the economics of the system, and day to day field conditions. Adding optimization of DERs to the TEP system will call for a new range of operating scenarios to be investigated. These scenarios will need to be developed from the loads up, rather than from transmission down.

The WIST Project Plan will identify these scenarios in general terms, and they will be investigated in more detail across early 2016. It is anticipated that the installation of the distribution optimization and control platform will suggest solutions. By mid-year, the WIST team will have settled on a set of experimental designs suitable for the anticipated WIST DERs. As WIST resources are specified, the experimental designs will be adjusted accordingly.

Solar DERs provide a good example of the planning that must underlie the WIST operating scenarios. As a byproduct of their normal DC/AC conversion function, smart solar Inverters can create reactive power (an AC current wave leading or lagging the voltage wave), which can be used to dynamically supplement or shave line voltage. A sufficient number of sufficiently-smart inverters can function similarly as distributed flexible AC transmission systems (FACTS) do for high-voltage lines. Smart inverters may become mandatory across the US through IEEE 1547. However, the preferred settings for a network of smart inverters is not obvious, as the inverters' actions must be coordinated to produce the desired overall result: real-time communications and control will be required. Nor are the costs and benefits of inverter-supplied grid regulation services yet clear.

The WIST operating scenarios will test the operations of DERs individually and in combination, assessing both technical performance and economic performance. The tests will be modeled across a range of operating dynamics that can indicate the distribution system's performance under typical and unusual conditions.

As field tests, the WISTs will have a number of variables in operation simultaneously, and will isolate results by running a number of these highly specific experiments. West Ina will continue as an operating substation during the WISTs, so these experiments will be designed against a background of the substation's normal operating conditions.

Evaluation

<u>The WIST Model</u>

The WIST has four objectives:

(1) demonstrate the feasibility, reliability, and value of utilizing DERs to <u>increase energy delivery efficiency</u>;

(2) demonstrate the feasibility, reliability, and value of utilizing DERs to <u>lower system reinforcement costs</u>;

(3) identify preferred operation and control protocols for <u>managing DERs</u> within TEP's system; and

(4) identify <u>other costs and benefits</u> that arise as a result.

Performance against these objectives is assessed against the WIST Model, which includes both a baseline and the observed experimental results. Like the test platform, the WIST Model is not an element being tested, it is one of the elements that enables the test itself. The WIST Model enables the implications of the experimental results to be understood, even if the experiments themselves are limited and specific.

The WIST Model will be built by TEP technical and financial staff at the design stage, and it will then be validated and employed by TEP's consultants (i.e., the Boice Dunham Group). It will identify constants and variables, and quantify the baseline relationships between them. It will provide hypotheses to test in each WIST experiment.

The WIST Model must perform properly for the WIST to work, so the initial WIST Model will then be adjusted three times as the project proceeds: (1) as vendor selection, contracting, and resource identification is complete; (2) as field construction and development are complete; and (3) as pre-operational WIST testing is complete.

The ongoing development of the WIST Model will help TEP to align initial objectives, field operations, and WIST analysis. The completed WIST Model will include a variety of hypotheses, operating scenarios, and test protocols.

Analysis

During WIST operations, WIST data will be carefully captured, stored, and cleaned to prepare for analysis. Data collection, validation, and analysis for the WIST will be very important, because the data from any individual experiment will have to be interpreted within the test design, and the test results will have to be extended across a number of operating scenarios TEP anticipates across its franchise.

Across design, development, installation, and operation, the WIST will generate the data required to model the technical performance and economics of DERs within TEP's system. WIST testing will also indicate what control methods and protocols are preferred in managing DERs.

Preliminary analysis will help guide the later stages of WIST. Data analysis will begin with the development of the WIST Model and the operating scenarios during design, and will continue through field-testing, operations, and evaluation.

The WIST data will be analyzed to determine technical performance and economic performance. First, the WIST will be designed to indicate the range of technical performance that TEP could achieve by managing DERs. Specifically, technical performance includes (1) the ability to effectively manage distributed resources (e.g., solar, energy storage, and demand response); (2) the ability to effectively execute new system operations strategies (e.g., Volt-VAR optimization, resource optimization); and (3) the demonstration of the energy delivery efficiency resulting from applying these abilities.

Since some of the DERs depend upon customer decision-making for their performance, one of the important kinds of analysis in the WIST will be to characterize the new load shapes and behaviors that customers adopt. The scale, reliability, persistence, and manageability of these resources will need to be modeled properly. Additional insight into customers will come from the 2016 demand charge residential research, and the recruitment of commercial and industrial customers for the 2017 WIST operation.

The WIST components should combine to provide technical performance meeting or exceeding TEP's established distribution performance metrics. The WIST should also identify feasible, productive, and long-term TEP operating metrics (e.g., reliability, availability). The WIST analyses of technical performance will be grounded in the WIST Model and the testing of explicit operating scenarios.

Second, the WIST components should combine to provide economic performance exceeding TEP's established distribution financial metrics. These established metrics result from typical top-down processes (e.g., reconductoring or adding feeders, upgrading substation transformers, adding substations). Even if several types of DERs have the potential to deliver technical performance, economic performance may be lacking for some of them.

Ongoing maintenance, reinforcement and expansion of distribution system capabilities can no longer be funded through revenues resulting from additional load. These functions must pay for themselves through the operating efficiencies and benefits they deliver. Identifying, quantifying, and documenting these operating efficiencies and benefits (e.g., capital deferral, maintenance savings) is a key objective of the West Ina field test. Specifically, economic performance is defined as achieving these efficiencies and benefits, while operating successfully according to the long-term TEP technical performance metrics.

It may be that while individual DERs seem uneconomic, particular combinations of DERs will prove quite valuable (e.g., as the Central Maine Power Boothbay Harbor project discovered when deploying distributed solar resources, energy efficiency, demand response, back-up generation, and energy storage in an effort to avoid transmission line upgrading).

After the formal field testing period, as independent evaluators, the Boice Dunham Group will complete a report (1) assessing the WIST against TEP's objectives for technical and operating performance, and (2) evaluating the potential for TEP improvements based on the WIST results. The nature and content of this report will be established by TEP as WIST design proceeds.

Completing the WIST will help set policy and strategy for DERs, TEP's customer relationships, and a future TEP Distributed Energy Resources Management System (DERMS).

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